Automatic satellite image processing chain for near real-time sugarcane harvest monitoring

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Abstract

Optimization of the productivity of sugar mills involves optimization of the logistics of sugarcane harvesting and milling operations. In many countries, sugarcane is produced by a multitude of growers with very poor access to information and communications technology. Hence, timely harvested area statistics are rarely available.

Yet, such data is crucial for sugar millers to adjust input supplies, allocate harvest equipment, manage cash flows, hire and manage staff, refine periods of operation, adjust yield prediction, etc. This presentation describes a sugarcane harvest monitoring system based on the processing of satellite image time series that produces harvest maps and harvested area statistics in near real-time.

We developed an optical image classifier and a radar classifier that produce binary maps of harvested vs non-harvested sugarcane areas at 10m resolution. Ground-truthing was achieved using a database associated with 147 fields. The data included the analyses of GPS tracks of harvesters, and Sentinel-1 (radar) and Sentinel-2 (optical) images from the ESA open data Copernicus Programme. We embedded the classifiers into a fully automated data processing chain running from the automatic download of available images over a study area, to the release on an online webmapping portal. This included pre-processing of the images: production of orthorectified backscatter radar images, and cloud free and bottom-of-atmosphere normalized difference vegetation index (NDVI) images.

Due to a combination of optical and radar images, and the short revisit-times of Sentinels satellites, the processing chain can produce harvest progress maps at desired intervals (a few days to weeks) regardless of cloud cover. As a result, this is frequent enough for decision making at mill level. It is based exclusively on open-source software (SNAP, SAGA GIS, PostGIS database, GDAL library, Linux bash shell, and QGIS server / QGIS web client for online publication) and runs on a Linux server. The data processing chain is therefore transferable without license costs. The processing time on an 8-core server is between 15 mins for radar image and 45 mins for optical images, including download time, which is acceptable for implementation on a small IT infrastructure. Moreover, the monitored site can cover several hundreds of thousands of square kilometers, making it a low cost and turnkey solution for near real-time monitoring of the harvest of a wide sugarcane production area.

Keywords: Open Source, open data, Sentinel, webmapping, radar